REMARKS

Favorable reconsideration and allowance of the present application are requested.

As an initial "housekeeping" note, the Examiner will observe that the present amendment is being filed concurrently with a formal Request for Continuing Examination (RCE) pursuant to Rule 114. Accordingly, entry of the present amendment and reconsideration in view of the remarks which follow are solicited during such continued examination.

By way of the amendment instructions above, all previous claims have been cancelled and replaced with new claims 53-63, of which claims 53-61 are directed toward the elongate tubular heat transfer elements according to the invention, whereas claims 62 and 63 are directed toward methods of forming such elongate tubular heat transfer elements according to the invention.

Thus, the applicants have focussed the newly presented claimed subject matter on the tubular forms of heat transfer element and the methods of making the same. Thus, the cancellation of all prior claims directed to the sheet-like product has been made without prejudice to the applicants' rights to file an appropriate divisional application with respect to such subject matter.

Moreover, newly presented claims 53-63 are of a scope to which applicants are deemed entitled. In this regard, the new claims do not mention any angle at which the spirally wound rovings extend in comparison to any axis. As will become clear from the discussion above, such a technical feature is not essential in order to define patentable subject matter over the applied references of record.

Accordingly claims 53-63 are now pending in this application for which favorable reconsideration and allowance are requested.

I. General Comments

As has been described previously prior art heat transfer elements have traditionally consisted of coated metal panels. However, these rely upon the integrity of the coating for successful operation.

There has also been proposed in United States Patent No. 4,461,347 (Santo et al.), as mentioned in the Applicants' specification, a heat exchanger assembly comprising coaxially arranged inner and outer pipes. The inner pipe can be formed of high strength metal and ensheathed by an extruded heat shrinkable plastics tube of non-reactive material, such as polytetrafluoroethylene or polypropylene. Another prior art proposal is for a plate heat exchanger comprising at least three plate elements consisting of graphite and a fluoropolymer, such as polyvinylidene fluoride is disclosed in European Patent Specification No. 0 203 213 A1 (Künzel). It is also proposed in British Patent Specification No. 2 255 148A (Moore et al.) to construct a structurally composite metal and plastics tube in which the metal forms a tubular core having openings throughout its length occupying at least 5% of its total surface area while the plastics material forms imperforate inner and outer layers, each at least 0.1 mm thick, covering the inside and outside of the metal core and integrally joined through the openings.

According to the present invention, novel tubular heat transfer elements and methods of making the same are provided. This can be made (as described, for example, in the Applicants' Example 6) by making a tape by consolidating glass fibre rovings which have been impregnated with polyvinylidene fluoride (or with a copolymer containing at least 80% of vinylidene fluoride) and then winding the tape onto to mandrel pipe. Again, the Applicants' tubular heat transfer element relies upon the presence of a high proportion of chemically resistant glass fibres to provide the necessary heat transfer characteristics. It is again emphasized that none of the prior art documents cited by the Examiner teaches such a use for glass fibres.

II. Response to 35 USC §112 Issues

The newly submitted claims 53-63 have been drafted with a view towards avoiding the issues raised by the Examiner under 35 USC §112. Accordingly, it is suggested that all such issues have been rendered moot by virtue of the new claims presented herewith.

III. Response to 35 USC §103 Issues

Claims all prior claims attracted a "final" rejection under 35 USC §103(a) as allegedly being unpatentable over the principal reference to Swozil et al. (U.S. Patent No. 5,211,220) either alone, or in combination with either or O'Connor or Yousuf et al. Applicants respectfully submit that neither Swozil et al, O'Connor nor Yousuf et al is appropriate as a reference against the presently pending claims.

The Examiner will recall the applicants' prior comments regarding Swozil et al. In order to prevent overburdening of the official record, such comments will not be repeated here, but are incorporated expressly by reference herein.

The Examiner will note the statement in Swozil et al that:

> "The concept underlying the [disclosed subject matter] is to improve tubes used in shell and tube heat exchangers in a mechanical manner, by covering the tubes with a fiber layer, since the tubes themselves are formed of fluorine-containing thermoplasts which cannot be reinforced by incorporation of fibers in practice, due to the very difficult processing which would then be required" (column 2 lines 12 to 18).

Thus, Swozil et al's teaching is that one must form a heat exchanger tube as a two layer item – namely, an inner tube consisting solely of PTFE and an outer reinforcing layer (or corset) which incorporates fibres. The unambiguous teaching of Swozil et al is therefore that one cannot make a monolithic heat exchanger tube.

One of the difficulties to which Swozil et al may be referring at column 32 lines 12 to 18 is that there was a prejudice in the art against using a mixture of glass fibres and fluorinated polymers together in processing machinery. In one unfortunate accident at least one fatality occurred as a result of an extrusion machine exploding when an attempt was made to re-commence operation with such a mixture after the heaters in the machine had inadvertently been left switched on overnight. A violent explosion occurred when the operatives re-started the machine and the fresh material encountered the hot residues left in the machine from the previous day.

The present applicants avoid such risks by using boron-free chemically resistant glass fibres and has received approval from the Health and Safety authorities to operate the process using the claimed materials. As illustrated by the applicants' Example 1, extrusion temperatures of about 200^{0}C are required in extrusion of polyvinylidene fluoride. Hence, when the extrusion machine involved in the fatal explosion mentioned above was left overnight, it is believed that traces of hydrogen fluoride were formed as a thermal decomposition product of the fluoropolymer. These traces of HF reacted violently with borates in the glass fibres when the extrusion machine was reactivated in the morning after the heaters in the machine had been left on overnight.

The applicants use boron-free chemically resistant glass fibre rovings (which incidentally were not even commercially available at the time the Swozil et al reference was filed, to the best of the applicants' knowledge) and hence avoids the risk of explosion due to interaction between the glass and any fluoropolymer or fluoropolymer decomposition product. According to claim 1 of Swozil et al and column 1 line 66 to column 2 line 11 the fibres are ***carbon*** fibres.

In contrast, the applicants' tubular heat transfer element is a monolithic item in which the polymer matrix extends from the inner surface to the outer surface with glass fibre rovings embedded therein. As noted previously, at the time Swozil et al was filed, boron-free chemically resistant glass fibres were not commercially available,

to the best of the applicants' knowledge. Accordingly, one skilled in the art reading Swozil et al would not interpret the passing reference to glass fibres (column 3 line 2, which is the only place in Swozil et al where glass fibres are mentioned) as referring to ***boron-free chemically resistant glass fibres***. Hence, applicants suggest that the person skilled in the art would not assume that Swozil et al taught use of boron-free glass fibres at all since such fibres were not available at the time that Swozil et al was filed.

The Examiner relies on column 3 lines 9 to 12 of Swozil et al in several places in the Office Action of August 25, 2003 (see, for example, page 10 middle of second paragraph and near the bottom of page 12). This teaching ("Basically all fluorine-containing polymers which can be brought into the fluid state as a melt, solution or dispersion are suitable as a coating material") is exemplified only in relation to carbon filaments (see the Example). Applicants note that the process described in the Example is in fact a sintering procedure. One skilled in the art would not regard it as applying to glass fibres at all because of the prejudice in the art against processing a mixture of a fluorine-containing polymer and glass fibres. In any event, this teaching applies only to the outside of the two layer construction of Swozil et al. The inner surface is not coated and consists of PTFE (see the Example).

Although column 2 lines 18 to 20 of Swozil et al states: "The coating covers each tube wall completely ...", applicants fail to see how wrapping the tube with carbon fibres as described in the Example and then coating them with PFA results in the inside of the tube being coated. As applicants understand this teaching, it would only be the outside of the tube that would be coated. Any assertion to the contrary would of course amount to speculation and would not be based on facts as stated or reasonably ascertained from the Swozil et al reference.

The secondary references to O'Connor and Yousuf et al are less pertinent than Swozil et al discussed above. Thus, since Swozil et al do not suggest at all the use of

glass fibres, and especially the boron-free chemically resistant glass fibres as claimed herein, the mere disclosure in O'Connor that thermoplastic materials may be reinforced with glass fibers generally (which the applicants certainly do not dispute) would still not cure the glaring deficiencies in Swozil et al with respect to the presently claimed tubular heat transfer element. As such, withdrawal of O'Connor et al is in order.

The secondary reference to Yousuf et al teach use of a fluoropolymer based powder for use as a powder coating composition (see column 1 lines 5 to 10). Such powder coating compositions are typically used for spraying metal objects. Thus Example 1 of Yousuf et al. describes use of the powder compositions made according to that Example for spraying on to an untreated aluminum panel. To make such a powder coating composition Yousuf et al teach that a fluorohydrocarbon polymer, such as polyvinylidene fluoride, is mixed with an acrylic polymer (see column 2 lines 40 to 46), and other ingredients, such as corrosion inhibiting pigments, dry flow promoting agents, antioxidants, adhesion promoters, and ultraviolet absorbing materials (see column 3 lines 15 to 24). The ingredients are melted, extruded under conditions giving a degree of crystallinity of at least 85%, and the resulting solid mass is then ground to give the final powder composition (see column 6 lines 25 to 40). The resulting powder can be applied to a substrate (such as an untreated aluminum panel) by any suitable means, including electrostatic spray apparatus, a cloud chamber, a fluidized bed, or triboelectric coating apparatus (see column 6 lines 51 to 55). This disclosure of Yousuf et al. is thus from a totally different art from the present applicants' invention and has nothing at all to do with manufacture of heat transfer elements. Moreover, even if it is permissible to combine the teachings of Swozil et al. and Yousuf et al. (which is not admitted), the end result would not be the Applicants' invention of a heat transfer element which contains as much as 20 to 60% by volume of the heat transfer element of boron free chemically resistant glass fibres so as to provide the necessary heat transfer characteristics. In this connection it is especially to be noted that Swozil et el. teach that the whole outer surface of polytetrafluoroethylene tube should not be covered

with glass fibres since that would have an adverse effect upon the heat transfer characteristics (see column 3 lines 34 to 36 of Swozil et al where it is recommended that larger meshes should be used since these "only insignificantly change the heat transfer coefficients of the tubes").

VI. Conclusions

In summary, the Applicants submit that the present invention, as defined by the newly presented claims, is unobvious over the applied references of record. As such, the present application meets all statutory requirements for patentability. Favorable reconsideration of the application is accordingly hereby respectfully requested.

Respectfully submitted,

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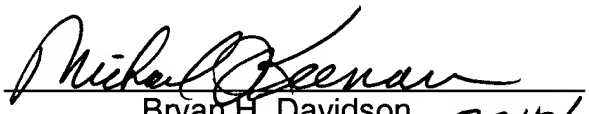
By: 
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